Data analysis of the lab

big idea: is momentum conserved in the collision of two marbles? Is kinetic energy?

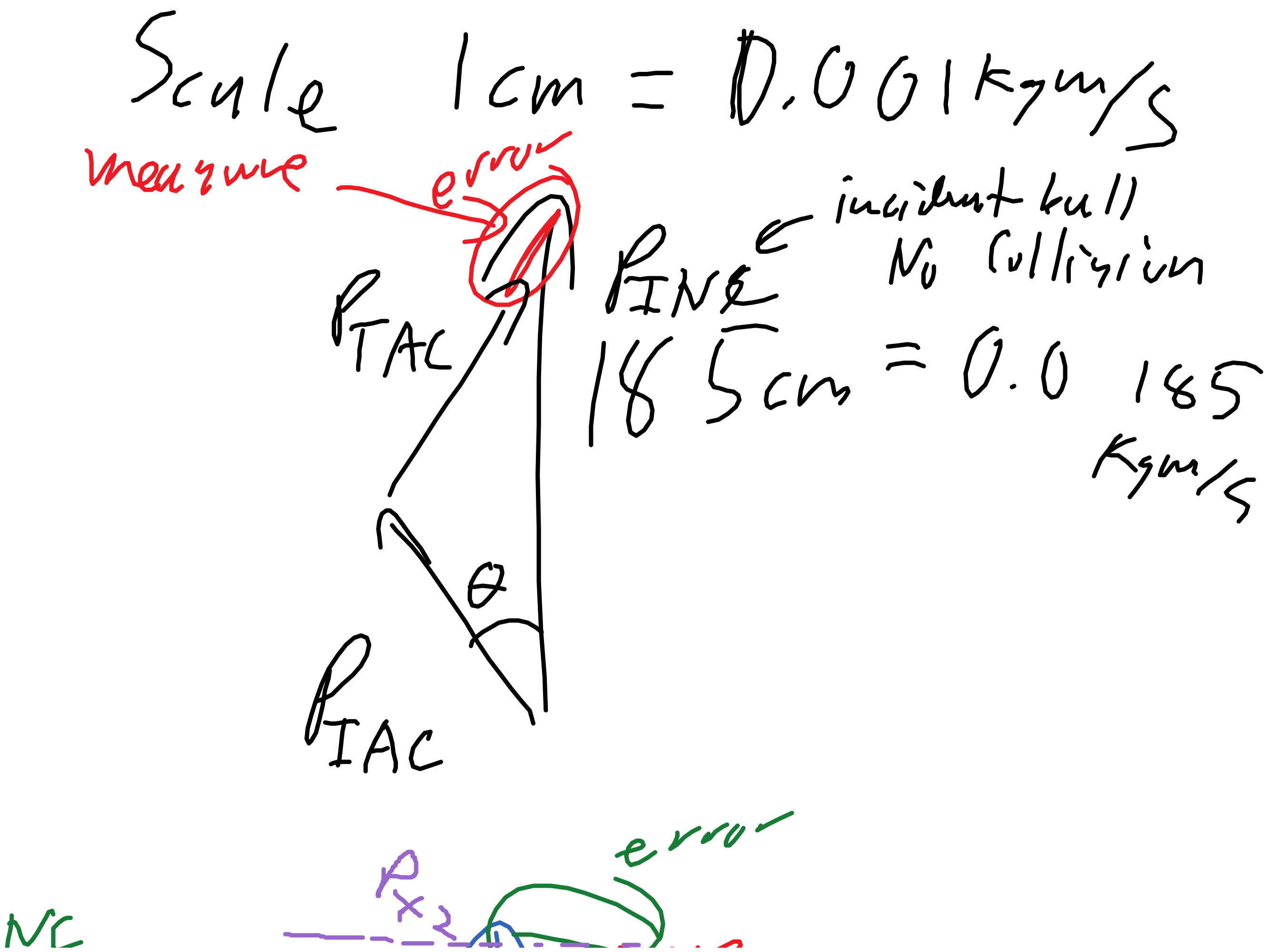
$p = mv = m\,s/t$ $h = 1/2at^2 + ut$ $u=0$ in y component

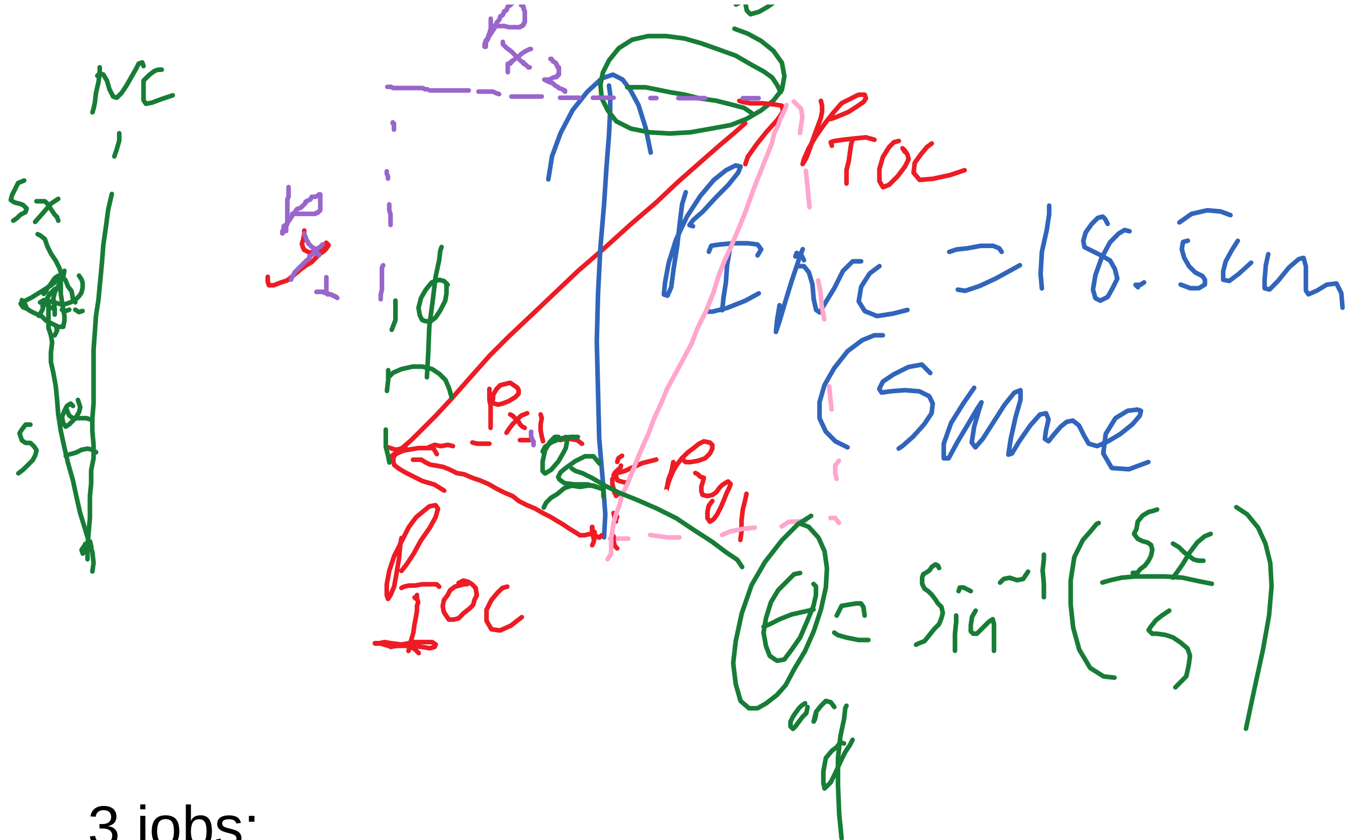
$t = \sqrt{(2h/a)}$ = Sqrt(2x0.915/9.81)=0.432 s is the time for all the balls to hit the floor.

p = 0.016x0.500/0.432=0.0185 kgm/s

$E_k = 1/2mv^2$ = 0.5x(0.016)x(0.5/0.432)^2=0.0107 J

Draw a scale vector addition diagram for your data for each collision:





3 jobs:

1. 2 scale vector addition diagrams of the momentum before the collision (Pinc) and the vector sum of the momentum after the collision (one diagram with Piac and Ptac another diagram with Pioc and Ptoc)

   2. calculate the components of the momenta after the collision, compare to the no collision momentum (difference = error)

   $p_x = p\sin\theta$ $p_y = p\cos\theta$

   watch, left is negative and right is positive

   $p_{xt} = -p_{x1} + p_{x2}$

   $p_{yt} = p_{y1} + p_{y2}$

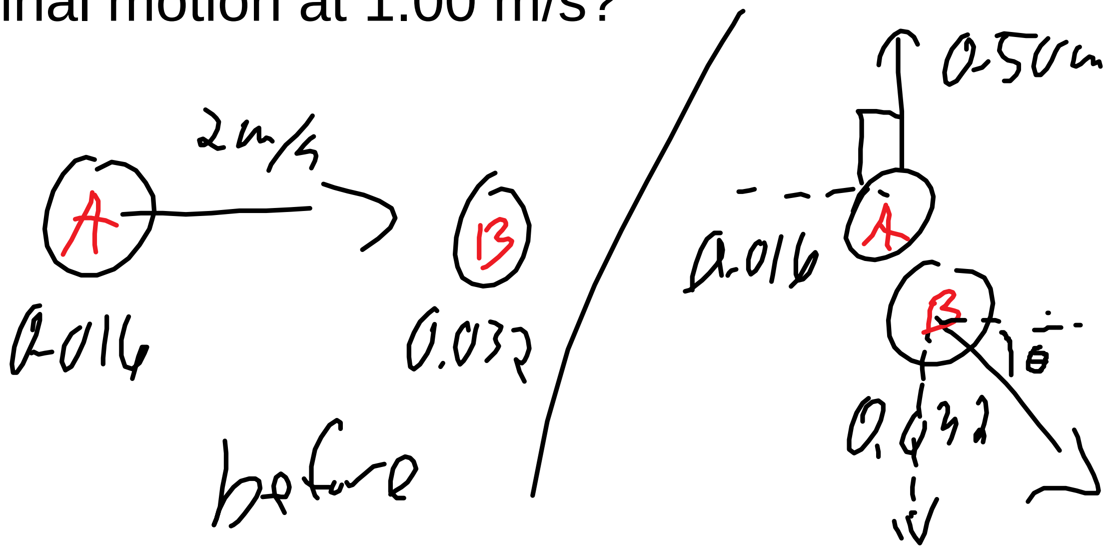
3. calculate kinetic energy before and after, compare

eg. a 0.0160 kg ball is moving at 2.00 m/s before it collides with a stationary 0.0320 kg ball at rest.

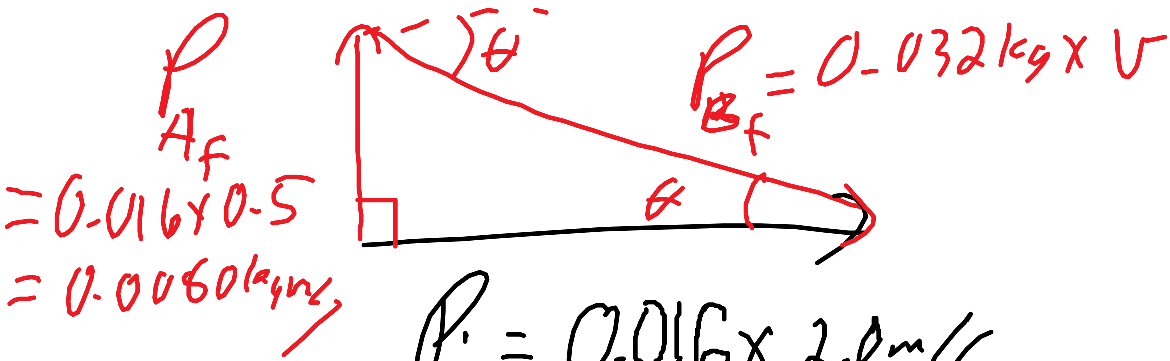
What is the velocity of the 0.0320 kg ball after the collision if

a) the 0.0160 kg ball moves off at 90.0º to the original motion at 0.50 m/s?

b) the 0.0160 kg ball moves off at 60.0º to the original motion at 1.00 m/s?



Big Idea $\Sigma P_i = \Sigma P_f$ ← vector sums

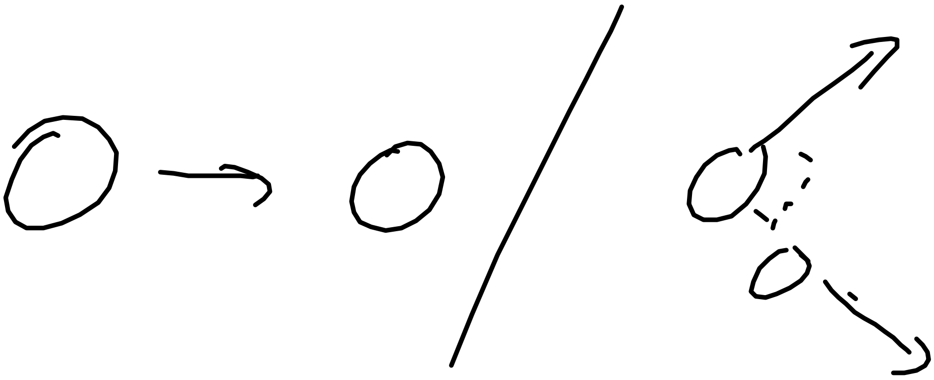


$P_{Ai} = 0.016 \times 2.0\ m/s$

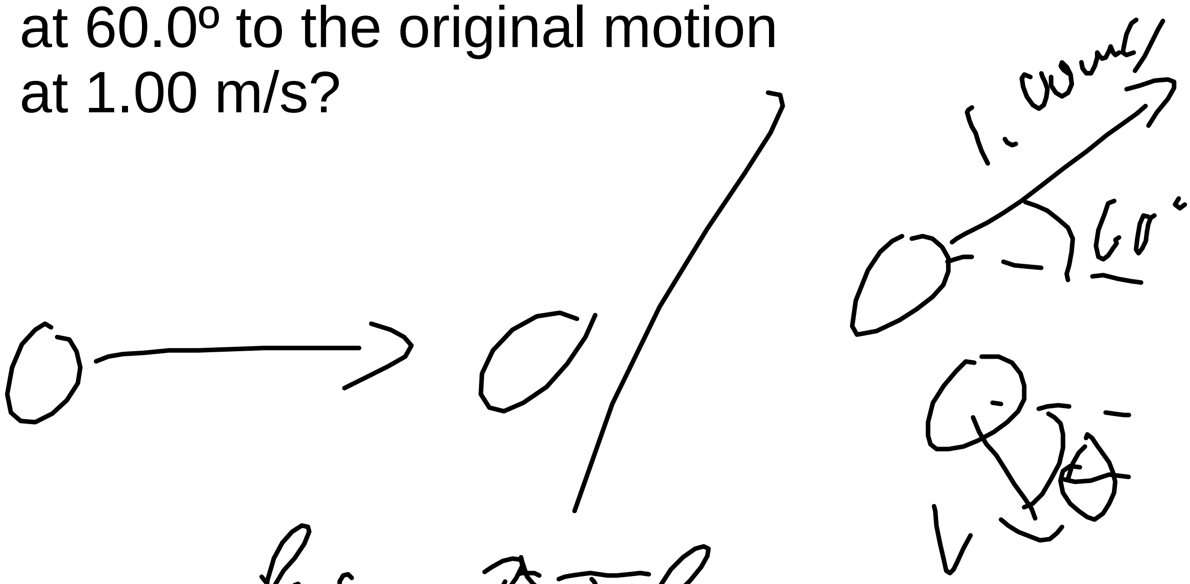
$= 0.032\ kgm/s + 0$ ← P_{Bi}

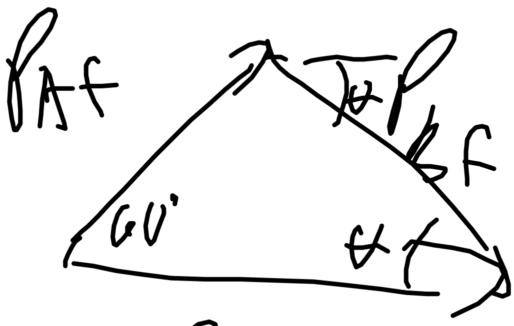
p_{bf} = Sqrt(0.008^2+0.032^2)= 0.0329848450049413

V_{BF} = 0.03298/0.032=1.03062
so the 0.032 kg ball rolls off at 1.03 m/s at θ = Atan(0.008/0.032)=14.03624346792648
14.0º to the original motion of the smaller ball opposite to the smaller ball



the 0.0160 kg ball moves off at 60.0º to the original motion at 1.00 m/s?





Pi = 0.032 kgm/s (same)
Cosine Law

$$P_{Bf}^2 = P_{Af}^2 + P_i^2 - 2P_{Af}P_i\cos 60$$

x: $$0.032 = P_{Af}\cos 60 + P_{Bfx}$$ ($P_{Af} \leftarrow 0.016$)

y: $$0 = P_{Af}\sin 60 + P_{Bfy}$$ ($P_{Af} \leftarrow 0.016$)

$$P_{Bf} = \sqrt{P_{Bfx}^2 + P_{Bfy}^2}$$

Sqrt(0.016^2+0.032^2-(2x0.016x0.032xCos(60)))= 0.027712812921102

V = p/m = 0.0277/0.032=0.8656 m/s